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PATENT SPECIFICATION

Convention Date (United States): March 4, 1936. **496,744**

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Specification not Accepted

COMPLETE SPECIFICATION

Improvements in or relating to the Manufacture of Pulp Rovings, Yarns and Twines

I, JOHN CARLETON SHERMAN, of 37, Ashton Road, Attleboro, Massachusetts, United States of America, a Citizen of the United States of America, do hereby declare the nature of this invention and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement:—

This invention relates to the conversion of paper-making pulp into rovings for conversion into stout yarns and twines comparable in physical characteristics to cotton-products of like weight.

For this purpose, the present invention consists broadly in forming on an endways movable foraminous carrier or screen, a wet ribbon of paper pulp, or a plurality of laterally spaced wet ribbon of paper pulp, partially and progressively dewatering the wet ribbon or ribbons by heat, or heat and suction, to the desired extent to permit it or them being converted successfully into a roving or rovings, and then converting the ribbon or ribbons, while on the carrier or screen, into a roving or plurality of rovings by a laterally applied rubbing, rolling or twisting operation.

The invention also comprises further dewatering of the resulting roving or rovings.

The invention also consists in means or apparatus for carrying out the invention above set forth.

Further features of the invention will appear from the following description and appended claims.

As in the practical carrying out of the invention, a plurality of laterally displaced wet ribbons of pulp will simultaneously be formed on the carrier or screen for conversion into a plurality of rovings, ribbons and rovings will be referred to in the following description:—

[*Price* 1/-]

The ribbons are best formed on a "cylindrical-mould" type of paper making machine, the cylindrical wall of which is unperforated except along selected, narrow, parallel circumferential drainage zones. Such a cylinder-mould is shown in the United States Patent No. 603,333 of May 3, 1898, granted to C. Kellner, though it is preferred to fit it with an internal suction quadrant such as will be hereinafter mentioned.

When a foraminous paper-making carrier or screen (hereinafter called the screen) is placed around such a mould, pulp will form into ribbons only over the circumferential drainage zones in the mould. By carrying an endless screen around less than the complete circumference of the mould and letting it extend beyond the mould, there can be obtained from the operation of the mould, a plurality of spaced wet-pulp-ribbons lying upon the screen for further treatment.

Each ribbon, so formed, may normally contain about nine parts of water to one of fibre, by weight, and is here defined as having a "water-to-fibre ratio" of nine-to-one. Other degrees of wetness will be hereinafter defined in like manner.

But pulp of the stated wetness is much too wet to be roved, (i.e. rolled up on itself in preparation for spinning). Hence the means hereinafter described for the progressive dewatering of the wet ribbons are of the essence of the present invention.

The ribbons must be so formed that in general their component fibres shall lie more or less longitudinally of the ribbons and the ribbons, when dried, shall preferably caliper only from one to two thousandths of an inch in thickness. Any materially greater thickness makes the subsequent spinning operation less effective. Therefore a paper-making pulp

is used having only about from three to five pounds of fibre in ten thousand pounds of water, and the cylinder-mould is run very fast.

By applying suction within the cylinder-mould, ribbons having a water-to-fibre ratio of about nine to one can then be formed.

The pulp ribbons thus formed, when rounded up, as will hereinafter be described, will hereinafter be called "rovings"; and for best results it is preferred to convert the ribbons into rovings when their water-to-fibre ratio has come down to about one-to-one, as in that event the resulting yarns will be bulky and softer than if rounded up while burdened with excess water.

The progressive dewatering of the ribbons, effected as hereinafter described, is vital, since, with the nine-to-one ratio, the ribbons do not react well to the roving operation and—even if so roved—cannot be collected in roving cans or on spools or the like, without undergoing deformation through the mutual pressure of superposed turns or coils, because of the dead weight of their excess water content. Furthermore, in spinning the rovings, their excess mass from large water-content, would increase the frequency of their breakage and require an expensive slowing down of the spinning operation. By the means to be hereinafter disclosed, there is secured for each step of the conversion process, the appropriate degree of progressive drying.

In the accompanying drawings, these means are conventionally shown in a manner sufficient, with the context, to enable anyone skilled in the textile and paper making arts involved, to carry out the invention.

Fig. 1 shows conventionally in longitudinal elevation, the apparatus preferred to be used.

Fig. 2 shows an alternative system of drying which may replace, as indicated, the corresponding details of Fig. 1.

In Fig. 1, a source of pulp stock is shown at 1, for delivering pulp stock through pipe 2, past valve 3, to the vat 4 in which may be a baffle-plate 5. The vat has no right hand end wall and its vertical side walls terminate on the right in an arcuate curve 6 adapted to abut, or nearly so, upon the endless screen 7 which extends around the cylinder-mould 8 for a distance less than the circumference thereof. The cylinder mould 8, which is of the kind hereinbefore mentioned, is internally fitted with a fixed suction quadrant, shown dotted at 8^a, through which water from the vat is drawn by suction through the outlet 9. The pulp ribbons are formed upon the screen 7, and one of them is shown stippled at 10. As the screen passes over a stationary suction box 11, the ribbons on the screen become slightly compacted as shown at 10^a. The suction box 11 is evacuated through a suction outlet 12. Because of the peculiar formation of the cylinder mould, as already described, the pulp which would ordinarily be formed in a wide sheet, is deposited on the screen 7 in the form of separate, parallel-lying ribbons, and the ribbon 10 to be here followed through the ensuing description, is typical of the one hundred or more of such ribbons on the apparatus.

On leaving the top of the suction box 11, the employment of which is optional—the screen 7 carries the pulp ribbons in their partially dewatered form 10^c directly into the heat of incandescent material which, in the drawing, consists of flaming gas from the gas jets 13, 13. The ribbons leave this heated area in a still more dewatered form 10^b and are carried by the screen over the upper of two rollers 14, 14 and then downward, the screen then returning to the cylinder mould, passing on its way under the lower roller 14, under the shower pipe 15 and under and over the guide-and-take-up rolls 16, 16. As the screen passes downward, under considerable tension around the rollers 14, 14, a suitable frame (not shown) carrying rollers 17, 17 with an endless belt 18 (of wire, leather or other material) stretched on these rollers, is brought into proximity to the adjacent portion of the screen 7, to bring the belt 18 into snug engagement with the ribbons upon the screen. An adjustable pressure-roller 14^a is provided to permit precise control of the said engagement.

The rollers 17, 17, the belt 18 and the frame which carries them, constitute a device familiar to the textile arts, wherein it is used to round up ribbons of shoddy or the like, and will hereinafter be called the "rubbing device".

These rollers 17, 17, are caused to oscillate on their axial lines—that is to say, in a plane perpendicular to that of the drawings, in a to-and-fro motion of about one quarter inch or less amplitude, in order to rub the ribbons. Provision should be made, by suitable cam-action, to control this amplitude. One or both of the rollers 17 must be so driven as to maintain the speed of the belt substantially equal to that of the screen. The rubbing action caused by the belt 18, changes the ribbons into "rovings" which emerge at 10^c to be swept up on to the first of a series of festoon rods 19, 19, etc., of a festoon dryer.

It is to be understood that the screen 7 is of considerable length so that the wet ribbons thereon shall be exposed to the flames of the jets 13 for from about one to three seconds. To indicate this construction, the screen 7 is shown broken on the vertical dotted double line X—X.

Similarly, the festoon dryer to be now described is of substantial extension, to suggest which it is shown broken on the vertical dotted lines Y—Y and Z—Z. The festoon rods 19 may be elevated by a chain system, shown dotted at 20, and carried by rollers 20^a, 20^a, 20^b, of which 20^b may be the driving roller. The rods may then be transferred to a horizontal track-system 21 of relatively rapid motion, the said system returning over idler 20^c. The rods are thence transferred to the slower track system 22 which may be driven by the driver 20^d. The rods can then be transferred to a descending elevator chain-system 23 driven by driver 20^d and spaced over idlers 20^e, 20^e. The rovings, shown entering the festoon, in partially dewatered form, as at 10^c, emerge as at 10^d sufficiently dried to be caught up on a warp beam or spool 24, or spread out laterally and distributed among numerous individual collectors of like form. Scraping blades D and D^1 may be applied to the screen 7 and the belt 18.

Fig. 2 shows an alternative form of apparatus beginning on the line E—E of Fig. 1, and is to be regarded as a substitution of the parts shown for those of Fig. 1 to the right of that line, similar reference letters and numbers applying to both figures.

In Fig. 2 the screen 7 is lengthened so that after it has passed the rollers 14, 14, it continues in a free curve 7^a until it rests on one or more table rollers 26^a, thence continuing over additional batteries of flame 13, 13, thence over table rollers 26^b, thence around rollers 27, 27 and in frictional contact with driving roller 25, whence it returns under shower pipe 15 and one of two take-up rollers 16 and thence over the other take-up roller 16 to the cylinder mould. The ribbons, of which one appears in further dewatered form at 10^d, are reeled up as at 24.

Since Fig. 2 is a condensed view, it is shown broken on the line X—X, as is also Fig. 1, and is also shown broken on the line Z—Z, to indicate the optional extension of the second flame-drying operation.

In further explanation of the drawings, it may be stated that the water content of the pulp ribbons, may rapidly be reduced during the travel of the ribbons from the cylinder-mould to the rubbing device, from a water-to-fibre ratio of nine-to-one to a ratio of one-to-one, by exposing them to a blue flame gas fire, the temperature of which may be above 500° F., without injury to the fibres, if such exposure is very brief. With small, thickly massed gas jets placed directly under the screen, the wet ribbons will endure exposure to flame of from about one to three seconds without charring. With the suction box 11 in use (whereby the water-to-fibre ratio can be reduced by suction alone, to three-to-one, the period of flame exposure may be shortened to from one to one and a half seconds; and, with the screen 7 moving forward five hundred feet a minute, the stretch of flame bathed screen need not exceed 12 feet.

By the means illustrated and described, the excess water is violently driven off from the fibre composing the ribbons without need of subjecting the ribbons to any wringing or squeezing operation after they leave the zone of influence of the suction quadrant 8^a within the cylinder-mould, unless for expediency, the additional suction means 11 be used. Inasmuch as the success of the invention lies in the subsequent intertwisting of individual fibres, and as this in turn is contingent upon their lying more or less longitudinally of the ribbon, it is evident that by preference as much drying by flame and as little by suction as conditions permit, should be done, since suction cannot twist but only jumble the fibres.

Within the general range of time intervals stipulated above, it is found that the incident heat is utilized to (so to speak) explode and drive off the water from the ribbons without raising the temperature of the ribbons or the screen to a harmful extent; but if by chance, such heat is held upon an element of the screen for a time long enough to drive off all the protective water content (say, five seconds) the ribbons burst into flame and the screen is soon ruined. Therefore it is essential that the gas-jet valves be so yoked to the driving apparatus of the screen that, upon stopping or slowing down the machine, the gas jets shall sink instantly to mere pilot jet size, or else that protective shutters be interposed between the jets and the screen in emergencies.

Apparently the flame drying effect reaches first the superficial water within the ribbons, and does not remove all the water which is, so to speak, "entrapped" upon or within individual fibres as the so-called "water of hydration." The process as described eliminates the undesired excess of water, instantaneously condition-

ing the ribbons to be rubbed and rounded while their constituent fibres are still limp and responsive to such rubbing and rounding operations.

As the screen 7 leaves the cylinder-mould 8 it carries no continuous "filter-mat" or web of fibres covering its whole width of surface but carries only narrow spaced longitudinal bands or ribbons of pulp. If the attempt be made to dewater these ribbons by suction alone, then the uncovered stretches of the screen tax the capacity of the suction pump and militate against successful dewatering. Even if suction, so impaired, suffices so to dewater the ribbons that they may be formed into rovings, and also to rid the open meshes of the screen from water, water will still flow from the ribbons themselves into these meshes between the ribbons, resulting in a continuous redistribution of free water. If, in the act of rounding-up the ribbons in the rubbing device, free water is so interchanged, any single droplet accumulated and passed again into a ribbon often causes a local weakness and either causes the roving to break or to split longitudinally. By means of the present invention, not only is each ribbon adequately dewatered but the screen itself is effectively freed from excess water.

Further, if wet pulp is dried by powerful suction upon a screen, fibres—especially the relatively long fine fibres required for textile uses—tend to become entangled upon and within the screen structure, and the ribbons are too narrow and too thin to endure much stress due to such entanglement. Hence suction is used sparingly to avoid crushing or matting of the fibrous mass.

Further, in the prior art, rovings formed with an excessive water content, have been too weak for conveyance from the rubbing device to any distant collecting means, since no such rovings possess adequate strength until spun. This trouble is also eliminated by the present invention.

Furthermore, the flame it is preferred to use which, as hereinbefore mentioned may have a temperature above 500° F., actually tends to lift the wet ribbons from the screen, this effect serving to facilitate the removal of the rovings from the screen, since it eliminates entanglement of individual fibres by the screen.

The simultaneous production of a large number of very fine rovings in closely spaced parallel lines on screen 7 is easy, but the subsequent conveyance of these in unbroken lengths, calls for care, and the apparatus outlined in Fig. 2 is best suited to cope with the problems incident to conveyance, when rovings are being made that are to be formed into yarns of 1 to 2 or finer count as reckoned on the established scale for cotton yarns. Such yarns take on great stoutness when twisted or spun but are tender in their unspun condition.

The natural tendency of the rovings is to fall free from the rubbing device, and in Fig. 2 they fall in contact with the free-curving stretch 7^a of the screen which gently cradles them as it conveys them to the horizontal position over the second battery of flames 13, 13. Since it is necessary to sustain this free curvature 7^a without avoidable vibration, one or more table rolls, of which one is shown at 26^a, may be located adjacent the curved stretch, and one or more similar rolls 26^b lying under the horizontal stretch of the screen, will augment the steadying effect.

The second exposure of the rovings to flames, as in Fig. 2, is preferably either briefer, or less intense, say above 300° F., than the first exposure, varying above 500° F. since in this latter phase the rovings now have an insufficient water content to save them from injury through prolonged or too intense heat.

The rovings made according to the invention may be collected in various ways, as in roving "cans" or on warp "beams," or on spools or creels, but—except when the rovings are dropped into cans—the linear speed of reeling up must be in step with the delivery speed of the production process. It is further desirable, in collecting the rovings, to conserve their remaining water content since stout yarns are best formed from rovings still wetted with some of their original water, and intermediate drying and re-wetting do not make for best results.

The unbroken formation and collection of the rovings made as described is facilitated by the lifting action of the flames upon the wet ribbons while they lie on the screen. This reduces the risk of their entanglement and enables high speed operation to be effected.

The system of progressive dewatering herein described, has a further advantage in that it conserves whatever stretchability the rovings may possess, since in the prior art, the unduly wetted rovings have undergone some stretching during conveyance because of their wet mass, whereas the improved rovings made as herein described, are better dried, and again the flames used have a certain shrinking effect on the fibrous ribbons. This consideration is of considerable importance in relation to the desired festoon drying as the improved rovings can enter the festoon with a relatively low water content and be so much the better

fitted to endure suspension without elongation.

While the invention is not limited to the use of a cylinder-mould, since there may be used alternatively, a fourdrinier type of forming machine, it is preferred to use a cylinder-mould fitted with the type of internal suction device shown in U.S. Patent 1758167 of May 13, 1930 granted to W. H. Millspaugh, as best ensuring that the fibres shall be " fished " from the pulp " end-on," and a suitable surfacing cylinder for such cylinder-mould (to take the place of the usual screen-surface) is hereinbefore described and is shown in sufficient detail in the hereinbefore mentioned U.S. Patent No. 603,333 to Kellner.

The specification and accompanying drawings are submitted as descriptive of the preferred types of apparatus used in carrying out the invention and not as implying limitations beyond the requirements of the prior art.

The " furnish " or character of pulp materials used, and filling and/or sizing ingredients used therein, are at the user's option The invention contemplates the use of chemical wood-pulp alone, or in admixture with ground wood, or any other type of pulp whether " free " or " slow," since the invention does not depend on suction alone for its dewaterment prior to roving. In fact for very stout yarns it may be preferred to employ a rather " slow " pulp for the sake of the important qualities it may have to ensure the firm interbonding of component fibres, though in general a " slow " pulp militates against softness of roving and/or yarn produced therefrom.

Similarly, as regards the source of incandescent heat, while naked flame is best, there may be substituted for the batteries of gas jets, a system of horizontally disposed pipes containing flowing " NS " fluid such being the commercial name of a mixture of univalent and trivalent metallic chlorine salts fluent when heated and capable of sustaining, without sensible pressure on its confining conduit, a temperature of 1500 degrees Fahrenheit. The heating and circulating of such fluid is, however, inconvenient, and does not provide for the rovings being produced, that uprush of blazing gas which is regarded as the especial merit of the gas flames used.

Similarly, as to the rubbing device, in a slow moving apparatus the belt 18 and the lower of the rollers 17 may be dispensed with, letting the reciprocation of the remaining upper roller serve to round-up the ribbons to form rovings.

When placing the gas flames and adjusting them, it is preferred to subject the ribbons at their wettest condition to the most intense heat and to reduce slightly the incident heat toward the drier phases of the process. This also is within the user's option.

As to the water-to-fibre ratios selected for explanation, it must be understood that considerable latitude is possible and indeed desirable to produce yarns of various qualities.

In general, the stated ratios are right but it should be noted that the wetness of a roving promotes strength in the final yarn, while relative dryness makes for softness at some cost of strength. The process hereinbefore described will enable long fibred pulp of high alpha-cellulose content to be converted into yarns of exceptional stoutness if the intermediate and progressive dewatering of the pulp ribbons and rovings be not carried to extremes. In fact, such yarns may greatly exceed in tensile strength, the cotton yarn chosen for comparison, but at the same time they may be deficient in softness and pliability. If, however, the control of the gas flames be suitably altered to carry the dewatering of the ribbons slightly further, yarns comparable in tensile strength to cotton yarn and of satisfactory softness and pliability, can be made.

It is with these reservations in mind, that the hereinbefore defined median range of water-to-fibre ratios, which is regarded as most consistent with average results, have been given, but without implying any limitation of the validity of the Applicant's claim to patentability. This reservation of rights is to be borne in mind in construing the appended claims.

Having now particularly described and ascertained the nature of my said invention and in what manner the same is to be performed, I declare that what I claim is :—

1. A method of forming pulp rovings and conditioning them for spinning, consisting in forming upon an endless foraminous carrier or screen from paper making pulp, a plurality of separate parallel ribbons having a high water content, reducing the water content of the ribbons by heat, with or without the aid of suction, rubbing the partially dewatered ribbons, while on the carrier, to convert them into rovings and further dewatering the rovings.

2. A method of forming pulp rovings according to claim 1, characterised by the fact that the wet ribbons, while upon the foraminous carrier, are partly dewatered by exposure to heat of incandescence and are withdrawn upon the carrier beyond the reach of the heat while they still contain sufficient water to prevent them being

injured by the heat.

3. A method of forming pulp rovings according to claim 1, characterised by the fact that the wet pulp ribbons, while upon the foraminous carrier, are partially dewatered by brief exposure to heat above the charring temperature of their dry-fibrous content and are withdrawn upon the carrier while they still contain enough water to prevent them from becoming charred and to enable them to be converted successfully into rovings.

4. A method of forming pulp rovings according to claim 1, characterised by the fact that the wet ribbons, while upon the foraminous carrier, are partially dewatered by exposure to flame and are afterwards withdrawn upon the carrier from the flame while still containing sufficient residual water to be converted into individual rovings by friction of a rubbing device while they are upon the said carrier.

5. A method of forming pulp rovings according to claim 1, characterised by the fact that the wet ribbons, while upon the foraminous carrier, are partially dewatered by suction, are further dewatered by exposure to naked flame and are afterwards withdrawn upon the carrier from the flame while they still contain sufficient residual water to prevent their ignition by the flame and to enable them to be converted by rubbing, while they are upon the carrier, into individual rovings.

6. A method of forming pulp rovings according to claim 1, characterised by the fact that the parallel pulp ribbons are first formed on the foraminous carrier with a water-to-fibre ratio of at least nine to one, are then dewatered by suction to a water-to-fibre ratio of about three to one and are then further dewatered by heat until they have a water-to-fibre ratio of about one to one and are then formed into individual ribbons by rubbing while upon the carrier.

7. A method of forming pulp rovings according to claim 1, characterised by the fact that the parallel ribbons are formed on the foraminous carrier from a fibrous pulp of a water-to-fibre ratio of about ten thousand to four.

8. A method of forming pulp rovings according to claim 1, characterised by the fact that the parallel pulp ribbons are formed on the foraminous carrier from an aqueous suspension of paper making material including chemical wood pulp.

9. A method of forming pulp rovings according to claim 1, characterised by the fact that the pulp rovings are conveyed in spaced parallel rows while upon the foraminous carrier through a free-swinging arm from a downwardly moving position to a substantially horizontally moving position, the said rovings remaining upon the said carrier during their further partial dewaterment, and being then progressively removed from the carrier for collection.

10. A method of forming pulp rovings according to claim 1, characterised by the fact that the initially wet pulp ribbons formed on the foraminous carrier are subjected initially and briefly to the full incidence of incandescent heat and are subsequently subjected, in the form of rovings, to a modified incidence of heat.

11. A method of forming pulp rovings according to claim 1, characterised by the fact that the wet pulp ribbons formed on the foraminous carrier are subjected initially and briefly to the direct incidence of naked flame through the apertures in the said carrier and are subsequently subjected, in the form of rovings, to the incidence of flame of lesser intensity through the said apertures in the carrier.

12. A method of forming pulp rovings according to claim 1, characterised by the fact that the wet pulp ribbons formed on the foraminous carrier are subjected to incandescent heat while they are sufficiently wet to ensure immunity from injury by the said heat, are then converted into rounded rovings by rubbing and the rovings then being partially dried on a festoon at a temperature substantially less than that of incandescence.

13. Apparatus for carrying out the method of forming and conditioning pulp ribbons according to claim 1, characterised by the fact that it comprises, in combination, an endless movable foraminous carrier upon which parallel ribbons of wet pulp can be deposited, a rubbing device between which and said carrier, wet ribbons of pulp thereon, can be converted into orvings, a source of heat arranged adjacent to said carrier and at the rear of said rubbing device, for partially dewatering the wet ribbons while upon the carrier, means for quickly withdrawing the carrier with the partially dewatered ribbons thereon from the source of heat and passing them through the said rubbing device for converting the ribbons into rovings, and means for further dewatering the rovings after passing from the rubbing device.

14. Apparatus according to claim 13, characterised by the fact that there is associated with the foraminous carrier and behind the said source of heat, a suction device whereby wet pulp ribbons on the said carrier can be subjected to a preliminary dewatering treatment before they are further partially dewatered by the source of heat.

15. Apparatus according to claim 13,

characterised in that the heat for partially dewatering the wet ribbons is constituted by a source of incandescent heat arranged closely adjacent to the carrier and ribbons thereon, and means for progressively withdrawing the said carrier and ribbons thereon from the zone of said heat.

16. Apparatus according to claim 13, characterised by the fact that the source of heat used for partially dewatering the wet ribbons while on the carrier is adapted to produce a higher temperature than 500 degrees Fahrenheit, to which the said carrier and ribbons are briefly and directly exposed.

17. Apparatus according to claim 13, characterised by the fact that the means for effecting further dewatering of the rovings, comprises means for producing heat at a higher temperature than 350 degrees Fahrenheit, to which the rovings are to be briefly exposed.

18. Apparatus according to claim 13, characterised by the fact that the means for progressively depositing separate parallel wet ribbons of pulp upon the carrier, comprises a vat for containing an aqueous suspension of paper making material, and a suction cylinder mould perforated to permit of drainage of water into its interior over narrow spaced circumferential zones over which the said foraminous carrier extends.

19. The herein described method of forming pulp rovings and conditioning them for spinning.

20. Apparatus for the forming and conditioning of pulp rovings, constructed, arranged and adapted for use as hereinbefore described with reference to the accompanying drawings.

Dated this 1st day of March, 1937.
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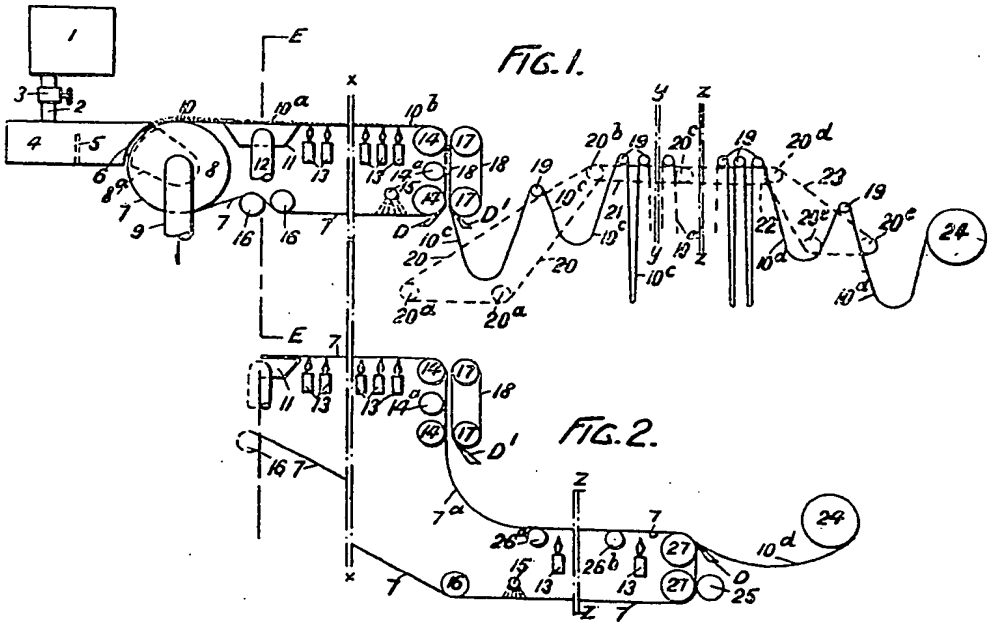

FIG. 1.

FIG. 2.

Malby & Sons, Lith.